

Constellation-X Science Requirements & ODRM Update

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FST Meeting, Nov. 19, 2003

Level 1 Science Requirements

- Translated from the mission scientific objectives.
- Requirements imposed by NASA HQ for the mission.
- Baseline requirements - mission is designed to these.
- Minimum requirements - constitute the science floor.
- Any descope options that violate Level 1 would require the approval of NASA HQ.
- Documents are: Level 1 Requirements; Science Requirements Document (specifics, science rational, includes mission goals)

Level 1 Requirements Summary






TRIP & TLRD

<u>Quantity</u>	<u>Requirement</u>	<u>Minimum</u>
Mission lifetime	5 years	4 years
Peak effective area	15,000 cm ²	12,000 cm ²
Energy range	0.25 - 40 keV	0.25 - 40 keV
Resolving power		
• 0.25 to 6 keV	300	300
• 6 to 10 keV	1,500	1,200
• 10 to 40 keV	10	5
Angular resolution		
• < 10 keV	15 arcsec	15 arcsec
• > 10 keV	1 arcmin	1.2 arcmin

Level 1 Requirements Summary - cont'

<u>Quantity</u>	<u>Requirement</u>	<u>Minimum</u>
Field of view		
• < 10 keV	2.5 arcmin	2 arcmin
• > 10 keV	8.0 arcmin	4 arcmin
Point source sensitivity	1.5×10^{-7} photons $\text{cm}^{-2} \text{s}^{-1}$	
Timing accuracy	100 μsec	300 μsec
Bright source capability	10,000 cps/beam	5,000 cps
Viewing efficiency	90%	
Source location	5 arcsec	
Sky coverage		
Background rejection		

Science Requirements Document (SRD)

-  Spells out our science objectives.
-  Lists key elements of the mission and each instrument that are applicable to performing these science objectives.
-  Currently basing on GLAST SRD.
-  Includes mission success criteria and reliability
-  Summary of all instrument requirements including mission goals

Science Objective 1



Measure effects of **strong gravity** near the event horizon of black holes.

- What is the nature of space & time?
- What powers supermassive black holes?

Category of targets: AGN, Galactic BHCs, XRBs

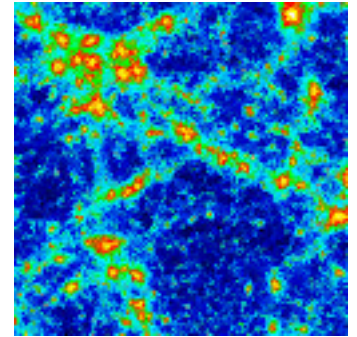
Key elements:

- broad bandpass, esp. up to at least 40 keV
- at least 6,000 cm² instantaneous area at 6 keV
- spectral resolving power of at least 1,500 at 6 keV
- angular resolution of at least 1 arcmin above 10 keV

Science Objective 2

Trace baryonic matter throughout the universe and constrain the nature of **dark matter** & dark energy.

- What is the universe made of?
- How does the universe evolve?

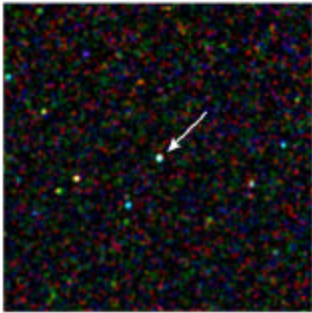


Category of targets: Clusters, groups, ellipticals, QSOs

Key elements:

- broad bandpass
- 15,000 cm² effective area at 1.25 keV; 1,500 cm² at 40 keV
- resolving power of at least 1,500 at 6 keV; 300 at 0.6 keV
- angular resolution of at least 15 arcsec at 1 keV
- FOV of 2.5 arcmin at 1 keV; 8 arcmin at 40 keV

Science Objective 3



Study formation of supermassive **black holes** and trace their evolution with redshift.

- What roles do they play in galaxy evolution?
- What is the total energy output of the universe?

Category of targets: AGN, spiral/Stb gals., faint sources

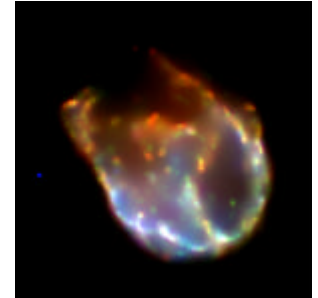
Key elements:

- broad bandpass, esp. up to at least 40 keV
- at least 15,000 cm² area at 1.25 keV; 6,000 at 6 keV
- spectral resolving power of at least 1,500 at 6 keV
- angular resolution of at least 15 arcsec at 6 keV

Science Objective 4

Study the **life cycles of matter** and energy & understand the behavior of matter in extreme environments.

- What new forms of matter will be discovered?
- How does the chemical composition of the universe evolve?



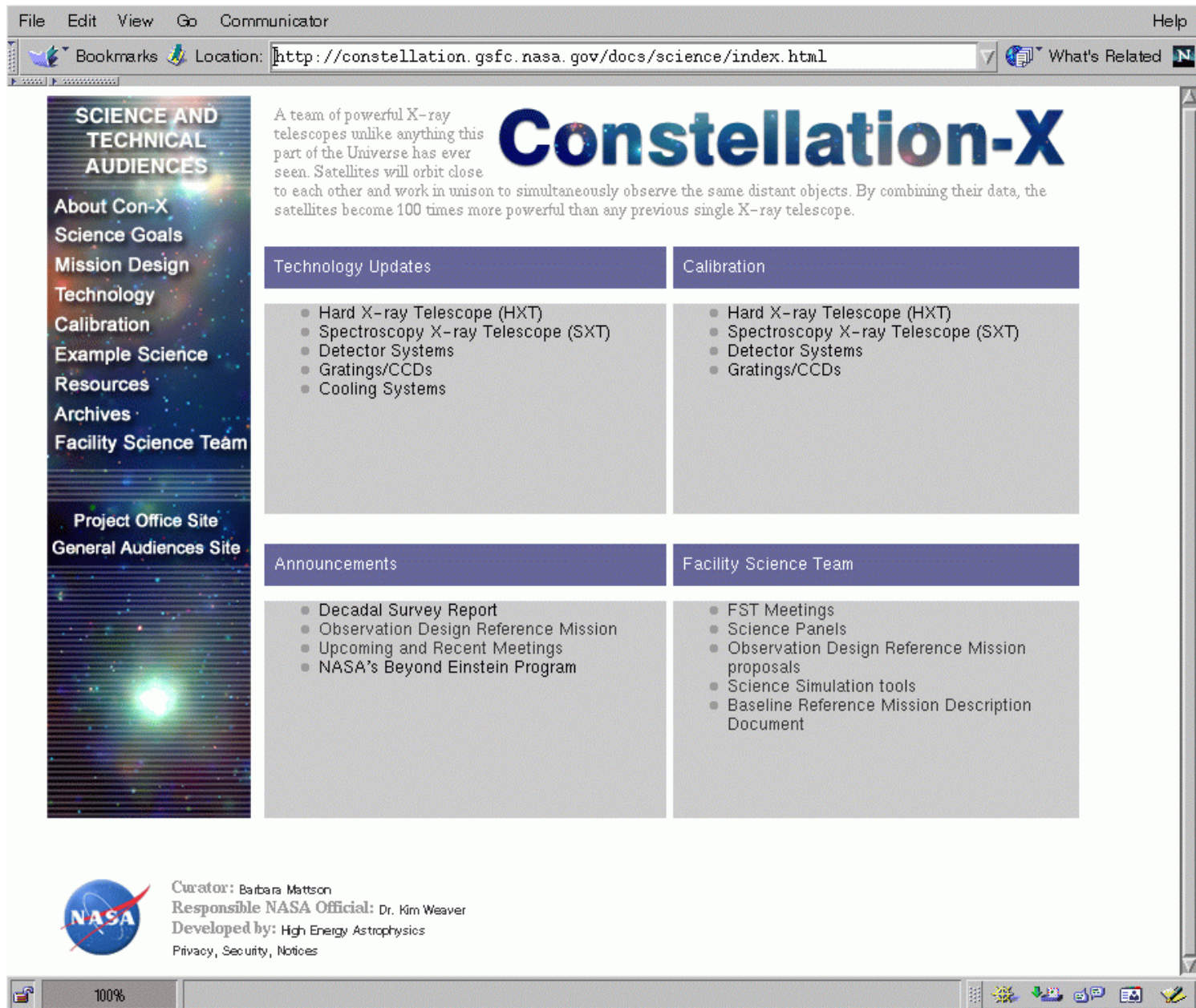
Category of targets: SNR, XRBs, BHCs, NS, stars, SS objects

Key elements:

- broad bandpass
- at least $15,000 \text{ cm}^2$ instantaneous area at 1.25 keV
- spectral resolving power of 1,500 at 6 keV; 300 at 0.6
- angular resolution of at least 15 arcsec at 1 keV
- FOV of 2.5 arcmin at 1 keV
- Timing accuracy 100 μsec ; bright source capability

Observation Design Reference Mission

- Describes scenario for the expected usage of Constellation-X for guest observer science.
- From this scenario we can derive slew rates, downlink volume, data storage requirements, power requirements, etc.
- ODRM will be used by industry to evaluate the satellite design.
- Help examine alternate requirements and pinpoint needed science trade-off studies.



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Bookmarks Location: <http://constellation.gsfc.nasa.gov/docs/science/drm/index.html> What's Related



**SCIENCE AND
TECHNICAL
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- About Con-X
- Science Goals
- Mission Design
- Technology
- Calibration
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Project Office Site
General Audience Site

Constellation-X

A team of powerful X-ray telescopes unlike anything this part of the Universe has ever seen.

Constellation-X Observation Design Reference Mission

The Observation Design Reference Mission (ODRM) describes a scenario for the expected useage of the Constellation-X satellite for guest observer science. It is partly based on informal proposals from the science community (for planning purposes only).

ODRM Proposal Forms

- Blank
- [Submit a proposal](#)

Supermassive Black Holes

- [Studying the Effects of Extreme Gravity with Constellation-X \(Weaver & Leaman\)](#)
- [Hard X-Ray Spectra of QSOs Over Range of Redshift \(Gorenstein\)](#)
- [Geometry of the Accretion Flow in AGN](#)
- [The Galactic Center - A Dormant AGN](#)
- [Heavily Absorbed AGN and the X-ray Background](#)
- [The High Redshift Universe](#)

Stellar Endpoints

- [Multiwavelength Observations of the Black Hole XTE J1118+480 in Quiescence \(McClintock et al.\)](#)
- [Searching for pulsations from quiescent neutron-star low-mass X-ray binaries \(Kaaret\)](#)
- [Constraining the mass/radius relation of neutron stars in X-ray bursters \(Kaaret\)](#)
- [Resolving Relativistic Effects and the Nature of the Accretion Flow Geometry of a Galactic Black Hole in Outburst \(Miller\)](#)
- [The Photosphere of Neutron Stars \(Walter\)](#)
- Stellar Winds
- Cataclysmic Variables
- Extragalactic Populations

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Location: <http://constellation.gsfc.nasa.gov/docs/science/drm/index.html> What's Related

- [Or a Galactic Black Hole in Outburst \(Winn\)](#)
- [The Photosphere of Neutron Stars \(Walter\)](#)
- [Stellar Winds](#)
- [Cataclysmic Variables](#)
- [Extragalactic Populations](#)

Galaxy Clusters and the Intracluster Medium

- [The interaction between the hot gas and radio plasma in Cyg A \(Worrall\)](#)
- [Imaging spectroscopy of soft X-ray emission from clusters of galaxies \(Lieur & Mittaz\)](#)
- [Cluster Cooling Flows](#)
- [Star Formation History in the Universe](#)

Galaxies and the Intragalactic Medium


- [Understanding the warm-hot intergalactic medium \(Mathur\)](#)
- [Dark Matter Distribution in the spiral galaxy NGC 891 \(Worrall\)](#)
- [Detecting the Missing Baryons in the Intergalactic Medium](#)
- [Abundances in Galactic Halos](#)

Stars, Supernovae, and the Interstellar Medium

- [OB stars in the Magellanic Clouds \(Cassinelli et al.\)](#)
- [Distribution of \$^{44}\text{Ti}\$ in Cas A \(Gorenstein\)](#)
- [Low Mass Stars in Tr 10 and the Vela OB2 Association \(Walter\)](#)
- [X-rays from Class I T Tauri Stars \(Walter\)](#)
- [Circumstellar absorption in the V471 Tau system \(Walter\)](#)
- [Kinematics of the Fe-rich ejecta in the SNR DEM 71 \(Hughes et al.\)](#)
- [TOO observations of SNIa \(Hughes et al.\)](#)
- [X-ray Doppler Imaging of the Active Binary 44i Boo \(Brickhouse\)](#)
- [Composition of interstellar medium](#)
- [Doppler Imaging of Active Binary Star Systems](#)

Solar System X-rays

- [High Resolution Study of Cometary X-ray Emission Due to Charge-Exchange \(Wolk, Lisse, Christian\)](#)
- [Jupiter](#)

 **Curator:** Barbara Mattson
Responsible NASA Official: Dr. Kim Weaver
Developed by: High Energy Astrophysics
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Bookmarks Location: http://cxc.harvard.edu/conx/blank_odrm.html What's Related

CON-X Observation Design Reference Mission Proposal Template.

- Please fill out this form fully before submitting.
- The most efficient way to fill out the Abstract and Science Justification may be to cut and paste from text files.
- Intermediate versions may be saved to disk with the SAVE button at the bottom, and reloaded with your browser's 'open file' button.
- When completed please enter your email address and hit the 'SUBMIT' button at the bottom. This will email a text and HTML version to you and to us.

Please answer as many of the following questions as possible for the scientific category of your choice. The members of the Constellation-X project team will use these responses to produce a Design Reference Mission document for use by industry. Although your response may be posted on our web site, we will not post the scientific justification. However, please consider writing a science justification to help the project team fully understand your science requirements.

1. Title of Investigation:

2. Science Category:

3. Abstract:

Taskbar icons: File Explorer, Internet Explorer, Runesoft, Network Places, Recycle Bin, Volume Control, Network Status, System Clock, Taskbar Buttons

Science trade studies:

- Extend overall bandpass to less than 0.25 keV (SXT) or greater than 40 keV (HXT)
- Increase resolving power from 300 to thousands at low energies and from 1,500 to 3,000 near 6 keV.
- Increase angular resolution from 15" to 5" HPD at <10 keV (SXT) and from 1' to 20" HPD at >10 keV (HXT)
- Increase field of view to larger than 2.5 arcmin (SXT) and larger than 8 arcmin (HXT)
- Increase bright source limit to greater than 10,000 cps/beam
- Absolute timing better than 100 microsec
- Others: sky coverage, etc.

Need to define impacts of the above.



Key Science not yet covered

- Cluster Cooling Flows
- Star Formation History in the Universe
- Heavily Absorbed AGN and the X-ray Background
- Cataclysmic Variables
- Extragalactic Populations
- Doppler Imaging of binary stars

Goals for completing the ODRM

Would like to have at least 1 proposal for each key science topic. The more input (and views) the better.

Opportunity to update proposals at any time. Send any new information to kweaver@cleo.gsfc.nasa.gov

New simulations and evaluations may be needed in conjunction with the science trade studies.

Ongoing opportunity to submit new proposals.

Will soon have draft ODRM available on our website.